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A Review of Technologies for Data Visualization for City- Traffic Flows

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ABSTRACT –

Since prehistoric times, city residents' travel habits and urban development have been interlinked. A prime example is the ancient Mesopotamian society, whose travel patterns were impacted by riverine design along with their way of life, culture, trade, and social rhythms. Urban planning regulates land use, livelihood, and popular tourist destinations, which results in the construction of a recognizable traffic pattern throughout the city. While re-engineering residents' mobility patterns and introducing change to the urban dynamics over time, spatial order forms the urban matrix.

***Keywords* – Intelligent transport system, GPS, ICT, Travel Advisory Systems, OSMnx**

I. Introduction

Urban development and growth depend on an understanding of how street networks are planned and designed. Researchers have attempted to develop this understanding by imagining the orientation of a street network. For instance, Mohajeri et al. [2] used directional analysis with histograms and roses to visualize the shorelines of three coastal cities in Brazil. Geoff Boeing's study [3] used concepts from graph theory and spatial analysis to investigate street networks and visualize their orientation grids by downloading data from OpenStreetMap These studies can provide metrics for network topologies and a clear picture of how a city street network is planned, which is helpful in the decision-making process for urban planning. From a transportation standpoint, it is essential to examine how well city street networks accommodate traffic flows in order to comprehend how and where people go. Because they had an impact on urban planning, the study of traffic patterns has always been a priority for transportation researchers. In many cities over the past 20 years, authorities and transport providers have invested in information and communication technologies (ICT) to promote digitalization and the creation of smart city planning [4]. Intelligent Transportation Systems (ITS) are one such instance of ICT that produce an unparalleled volume of spatiotemporal datasets that may help us better understand how people navigate inside cities.

II. TECHNOLOGIES

A. Intelligent Transport system:

An unprecedented amount of spatiotemporal datasets are produced by intelligent transport systems (ITS), an example of ICT (Information and Communication Technologies), which could improve knowledge of citizens' intracity spatial mobility patterns. Big Data produced by ITS has benefits and drawbacks for the study of human transport behaviors. To visualize and understand travel behavior, these records were analyzed using a number of different techniques. Academics have used such data, including Origin Destination (OD) and traffic flow data, to obtain critical understanding of how and where people move about a metropolitan network. Data collection, analysis, and use of the analysis's findings in traffic management operations, control, and research concepts where location is important form the foundation of the full use of ITS. An integral part of ITS is the traffic management center (TMC). Most of the time, the transportation authorities' control over it is technical. Here, all information is gathered and analyzed for use in operations in the future, real-time traffic management, or data on local transportation vehicles. The Traffic

Management Centre's organized and effective operations rely on automated data collection with precise location information, processing of that data to produce accurate information, and delivery of that information back to travelers. Let's examine each step of the procedure in more detail.

1) *Data collection*: Real-time monitoring and precise, comprehensive, and timely data collecting are required for strategic planning. As a result, information is gathered here using a variety of hardware tools that provide the basis for additional ITS actions. These tools consist of sensors, cameras, GPS-based automatic vehicle locators, Automatic Vehicle Identification (AVI), and more. The equipment mainly keeps track of information like traffic volume, surveillance, journey time and speed, position, vehicle weight, delays, and so forth. These actual objects are connected to computers, which are frequently installed in data collection facilities and store enormous amounts of data for later processing.

2) *Data Transmission*: The ability to exchange information quickly and in real time is essential for successful ITS implementation, hence this section of ITS involves sending data from the field to TMC for analysis before returning it to travelers. Traffic: Via the internet, SMS, or on-board vehicle gadgets, travelers are alerted of pertinent announcements. Other communication methods include cellular connectivity- and infrared-based Continuous Air Interface Long and Medium Range (CAILM) and radio-based Dedicated Short-Range Communications (DSRC).

3) *Traveler Information*: Travelers can receive transport information through Travel Advisory Systems (TAS). The system offers real-time data on things like trip time, travel speed, delay, traffic accidents, route modifications, detours, the state of construction zones, and more. A range of electronic tools, including variable message signs, highway advisory radio, the internet, SMS, and automated cell phones, are used to disseminate this information. As urbanization picks up speed, there are more vehicles on the road. Both together put tremendous pressure on cities to maintain an improved transportation system in order to ensure uninterrupted city flow. The only solution for this is an application of the Intelligent Transport System. ITS is a win-win situation for local administrators and residents when it comes to safety.

B. OSMnx: Python for Traffic Networks

OpenStreetMap street networks can be retrieved, modelled, analyzed, and visualized using the Python application OSMnx. Users can download and build walkable, drivable, or bikeable metropolitan networks with just one line of Python code, which can then be quickly analyzed and visualized. Figure 1 illustrates how easy it is to download and use building footprints, elevation data, street bearings and orientations, and network routing.

Fig 1: Italian city of Modena's street layout [18]

C. How to use OSMnx:

- Automatically download administrative place borders and shapefiles Save and simulate street networks Optimize and simplify network topology

- Save shapefiles, GraphML, or SVG versions of street networks to a disc.
- Examine street networks, including their routing, visualization, and statistics.

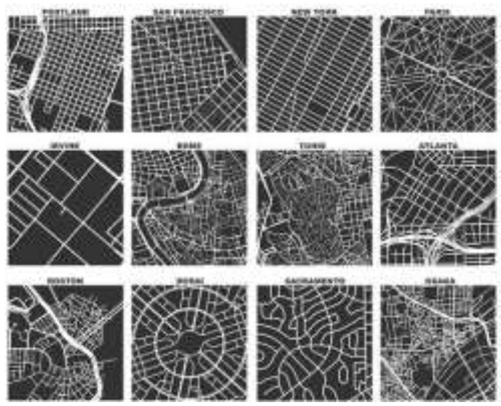

Fig 2: The only tool needed to create figure-ground diagrams is OSMnx. [18]

III. ADVANTAGES

- Data Visualization makes it possible for us to swiftly and precisely interpret the data.
- Information design enables us to spot developing patterns and take swift action in response to what we observe.
- Display the street orientation in relation to citywide travel patterns.
- Evaluate the usability of the city's street network.
- Network orientation and traffic volume orientations can provide us a comprehensive understanding of how people move across a city's roadway network.

IV. FUTURE SCOPE AND CONCLUSION

A. FUTURE SCOPE

It would be possible to determine what mitigation strategies could be required to strike a balance between the built-in network and traffic demands with more examination into street networks.

A highly mobile network, a habitable environment, and more effective laws all depend on striking this equilibrium. The created visualizations are effective in observing network traffic across all apps. For instance, by keeping an eye on these visualizations, routing suggestions may be made as necessary to relieve congestion by diverting traffic from a group of heavily utilized streets to less-used streets in order to strike a balance and spread congestion somewhat uniformly across a network.

By developing separate visualizations for bike lanes vs. bicycle traffic, transit routes vs. transit ridership, and city streets vs. vehicular traffic, the respective transportation authorities will be greatly assisted in identifying sustainable solutions for livable and smart cities.

B. CONCLUSION

This work offers a technology for visualizing citywide travel patterns.

- A method of identifying the city street network locations where people travel the most; and
- Consider the differences between network order and travel orientation while evaluating the usefulness of the city's street network.

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